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Identifying modern *Neogloboquadrina pachyderma* morphotypes from the Central Arctic Ocean through supervised machine learning – a comparison between water column and seafloor sediment populations

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Planktonic foraminifera tests are commonly used in geochronology and palaeoceanographic reconstructions as micropaleontological and geochemical proxies. In the high latitude North Atlantic and Arctic, the polar specialist *Neogloboquadrina pachyderma* is the most common planktonic foraminifera and is known for its morphological plasticity, resulting in the identification of at least 5 morphotypes within a single genotype. The significance of its morphological variability remains uncertain, with hypotheses linking it to ecological/environmental differences, and/or life history stages. However, *N. pachyderma* morphotype analysis has been largely limited to sediment studies, lacking a systematic exploration of water column populations. Here, we explore this question using a novel supervised machine learning (SML) and automated image processing (AutoMorph software) approach to acquire large morphometric data sets on populations of Central Arctic *N. pachyderma* from 8 paired plankton net and sediment (box-core) sample sets. This study addresses the ability of SML to discern the established morphotypes and whether alternative morphological models can better represent the morphological diversity. Additionally, this study explores how morphologic variability in living *N. pachyderma* populations compare with their sedimented counterpart.

The results, based on approximately 15.000 *N. pachyderma* morphotypes, represents the largest data set for a single planktonic foraminifer species and the largest study of this kind based on water column populations in the Arctic Ocean. The highest specimen abundance was found in the upper 100m. Preliminary findings indicate a dominance of small (55-120µm) *N. pachyderma* specimens, assumed to be juveniles, whereas the sediment assemblage is dominated by heavily encrusted, larger morphotypes. The water column and sediment assemblages are mismatched, potentially due to the much narrower time window recorded in the water column compared to the annual-millennial timescale in the sediments. This study provides new insights into how ecology and life history of *N. pachyderma* translates to test morphology – a crucial aspect for taxonomy

and geological studies.